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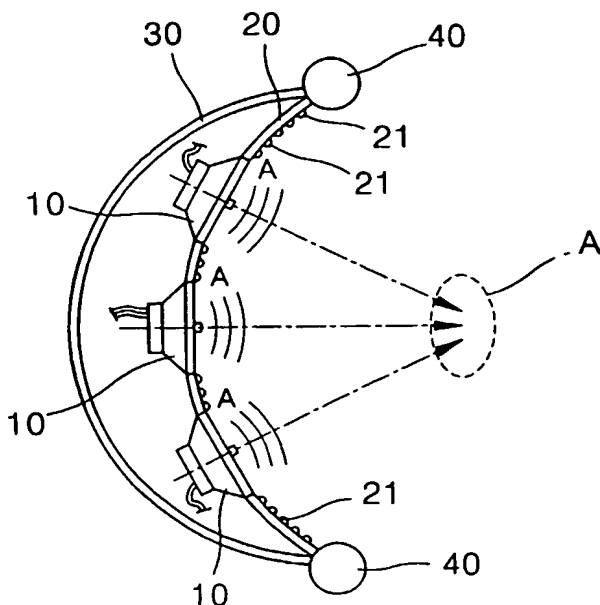
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(54) Title: **MULTI-CHANNEL HEADPHONE**



(57) **Abstract:** A multi-channel headphone capable of focusing and wide staging when forming a multi-channel sound field is provided. The multi-channel headphone comprises a plurality of multi-channel speaker units, a sound wave guide in which the speaker units are disposed at predetermined intervals and which has a concave inside so that a sound wave generated by the speaker units travels toward a listener's ear hole zone, and a case, which surrounds and protects the rear surfaces of the sound wave guide and the speaker units.

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## MULTI-CHANNEL HEADPHONE

### Technical Field

- 5           The present invention relates to a multi-channel headphone, and more particularly, to a multi-channel headphone capable of focusing and wide staging when forming a multi-channel sound field.

### Background Art

- 10           In general, a conventional multi-channel headphone has a structure in which a plurality of speaker units having separate channels are horizontally disposed in one direction to correspond to a listener's ears.

- In other words, the conventional multi-channel headphone has a  
15           structure in which a directional point at which each speaker unit faces is not uniquely positioned inside the listener's ears but dispersed in several places, the speaker units almost contact the listener's ears, and an echo space in which a sound field (staging) is to be formed does not exist.

- Accordingly, the conventional multi-channel headphone does not  
20           have an optimum ratio of direct sound to indirect sound of 7:3. That is, direct sound generated in each speaker unit does not directly reach an ear hole zone, which is the listener's ears most sensitive part, and the most part of the direct sound is reflected and becomes indirect sound. As such, since all sounds reaching the ear hole zone are reflected  
25           indirect sounds, the sounds are not clear, and sound resolution is severely lowered. In addition, the listener does not perceive a directional sensitivity of each channel outputting sound in the front, back, and laterally of the listener's ears. As such, the conventional multi-channel headphone has low sound separation capacity, and the  
30           listener does not sense a field sensitivity of multiple channels.

          In addition, since the direct sound generated by each speaker unit is reflected and changed into indirect sound and there is no echo space

in which sound-field sensitivity and spatial sensitivity are to be sufficiently formed, due to collision with indirect sounds or interference, the direct sound is changed into noise, a sound quality is lowered, a desired scattering rate of sound wave cannot be induced, and sound quality cannot be improved.

#### Disclosure of the Invention

The present invention provides a multi-channel headphone which improves sound resolution by using a concave sound wave guide so that a directional point at which each speaker unit faces is positioned inside an ear hole zone, and which increases sound separation and field sensitivity of multiple channels by improving a directional sensitivity of each channel.

The present invention also provides a multi-channel headphone with increased spatial sensitivity and sound-field sensitivity by respectively reflecting a part of direct sound generated in a speaker unit into a sound wave guide and changing the direct sound into indirect sound and by scattering noise caused by collision with indirect sounds or interference, and simultaneously, a multi-channel headphone with improved sound quality by forming the sound wave guide and scattering protrusions and by tuning a scattering ratio and reflectivity.

According to an aspect of the present invention, there is provided a multi-channel headphone comprising, the multi-channel headphone comprising a plurality of multi-channel speaker units; a sound wave guide in which the speaker units are disposed at predetermined intervals and which has a concave inside so that a sound wave generated by the speaker units travels toward a listener's ear hole zone; and a case, which surrounds and protects the rear surfaces of the sound wave guide and the speaker units.

In addition, in order to constitute multiple channels, such as 3.1 channel, 4.1 channel, 5.1 channel, 6.1 channel, and 7.1 channel, each of the multi-channel speaker units may comprise a center-channel speaker

unit, which is installed in an upper side of the sound wave guide; a front-channel speaker unit, which is installed in the front of the sound wave guide; a rear (rear-center)-channel speaker unit, which is installed in the rear of the sound wave guide; a side-channel speaker unit, which is installed in the center of the sound wave guide; and a multi-woofer channel speaker unit, which is installed in a lower side of the sound wave guide.

In addition, in order to improve a sound quality and to widen a reversible regeneration frequency, a separate inner enclosure for surrounding a rear surface of the multi-channel speaker unit may be formed in the multi-channel speaker unit, an enclosure of the center-channel speaker unit, the front-channel speaker unit, the side-channel speaker unit, and the rear-channel speaker unit may have a closed shape, and the woofer-channel speaker unit may have no enclosure, or an enclosure thereof may have an opened shape (base reflector type).

In addition, in order to perform precise tuning of a sound quality, the sound wave guide may have a domy or concave shape in which a curvature radius and a reflection/anti-reflection surface processing ratio are determined according to a ratio of desired direct wave to reflected wave, and a plurality of scattering protrusions, which induce scattering of the sound wave so that a sound field is formed inside the speaker unit, are formed in the sound wave guide, and the sound wave guide may include a first domy sound wave guide for surrounding a listener's ears and a second domy sound wave guide for surrounding each speaker unit in the first domy sound wave guide.

Meanwhile, in order to effectively dispose the plurality of speaker units in a narrow space not to overlap one another, an inner barrier wall, on which an embedded speaker unit is fixed, may be installed so that the embedded speaker unit is installed in the case, and a sound guide tube, which communicates with a sound wave exhaust hole of the sound wave guide from a front surface of the embedded speaker unit, may be

installed so that sound wave generated in the embedded speaker unit fixed on the barrier wall is guided to the sound wave guide.

#### Brief Description of the Drawings

5           The above and other aspects and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

FIG. 1 is a side cross-sectional view illustrating one side of a multi-channel headphone according to an embodiment of the present  
10 invention;

FIG. 2 is a front view illustrating an inside of FIG. 1;

FIG. 3 is a side cross-sectional view illustrating one side of a multi-channel headphone according to another embodiment of the present invention;

15           FIG. 4 is a side cross-sectional view illustrating one side of a multi-channel headphone according to an embodiment of the present invention;

FIG. 5 is a side cross-sectional view illustrating one side of a multi-channel headphone according to an embodiment of the present  
20 invention; and

FIG. 6 is a side cross-sectional view illustrating one side of a multi-channel headphone according to an embodiment of the present invention.

#### 25   Best Mode for Carrying Out the Invention

Hereinafter, the present invention will be described in detail by describing exemplary embodiments of the invention with reference to the accompanying drawings.

As shown in FIGS. 1 and 2, a multi-channel headphone,  
30 according to an embodiment of the present invention, for constituting multiple channels, such as 3.1 channel, 4.1 channel, 5.1 channel, 6.1

channel, and 7.1 channel, includes a plurality of multi-channel speaker units 10, a sound wave guide 20, and a case 30.

Here, each of the multi-channel speaker units 10 receives a multi-channel sound signal output from an amplifier (receiver).

5 As shown in FIG. 2, each multi-channel speaker unit 10 includes a center-channel speaker unit 11 installed in an upper side of the sound wave guide 20, a front-channel speaker unit 12 installed in the front of the sound wave guide 20, a rear (rear-center)-channel speaker unit 13 installed in the rear of the sound wave guide 20, a side-channel speaker  
10 unit 14 installed in the center of the sound wave guide 20, and a multi-woofer channel speaker unit 15 installed in a lower side of the sound wave guide 20. In addition, the speaker units 10 may be disposed in a variety of positions so that a sufficient sound-field sensitivity is formed.

15 Accordingly, two identical center-channel sound signals are input into the center-channel speaker unit 11 so that a virtual center channel is formed in the front of the listener's ears, and a front channel is formed on front right and left of the listener's ears, a side channel is formed on right and left of the listener's ears, a rear channel (or virtual rear-center  
20 channel) is formed on rear right and left of the listener's ears, and two identical woofer-channel speaker units 15 form a multi-woofer.

The sound wave guide 20 is an installation surface in which the speaker units 10 are fixedly installed. The speaker units 10 are disposed in the sound wave guide 20 at predetermined intervals. The  
25 sound wave guide 20 has a domy or concave inside so that each sound wave generated in the speaker units 10 faces a listener's ear hole zone A. The sound wave guide 20 focuses a direction of each of the speaker units 10 concavely and forms a circular dome inside the speaker units 10, thereby forming an echo space. The sound wave guide 20 may have all  
30 shapes in which a concave echo space is formed, as well as the domy shape.

In addition, a curvature radius and a reflection/anti-reflection surface processing ratio of the sound wave guide 20 are determined according to the ratio of desired direct wave (sound wave directly transferred from a speaker unit to a listener's ears) to reflected wave  
5 (sound wave generated in the speaker unit, which is reflected on several reflective surfaces and is indirectly transferred to the listener's ears), and a plurality of scattering protrusions 21 which induce scattering of the sound wave to form a sound field inside the sound wave guide 20, are formed in the sound wave guide 20.

10 Accordingly, a designer determines the domy curvature radius or reflectivity of the sound wave guide 20 and the shape of the scattering protrusions 21 such that optimum sound-field sensitivity, field sensitivity, and high sound quality are acquired.

In addition, a cushion ring 40 is installed in a rim of the sound  
15 wave guide 20, and a vibration element (not shown) is connected to the cushion ring 40 so that the listener can feel sound vibration when playing games.

In addition, the case 30 surrounds and protects the rear surfaces of the sound wave guide 20 and the speaker units 10. The case 30  
20 closes a reverse-phase sound generated in the rear surface of the speaker units 10.

Meanwhile, as shown in FIG. 3, a separate inner enclosure 50 for surrounding the rear surface of the multi-channel speaker unit 10 is formed in each of the multi-channel speaker unit 10. The enclosure 50  
25 may have a closed shape in which all speaker units 10 are completely closed. However, as shown in FIG. 4, each enclosure 50 of the center-channel speaker unit 11, the front-channel speaker unit 12, the side-channel speaker unit 14, and the rear-channel speaker unit 13 has a closed shape, and the woofer-channel speaker unit 15 has no  
30 enclosure, or the enclosure 50 thereof has an opened shape (base reflector type) in which a vent 22 is formed, thereby reinforcing a low frequency band.

Here, the case 30 has a concave inside so as to induce rear surface reflection of the base reflector type speaker unit, that is, the woofer-channel speaker unit 15, or a short sound guide tube 23 which guides reflected sound wave to the sound wave guide 20, is installed in the case 30.

In addition, as shown in FIG. 5, the sound wave guide 20 includes a first domy sound wave guide 201 for surrounding a listener's ears and a second domy sound wave guide 202 for surrounding each speaker unit in the first domy sound wave guide 201 so that the listener can feel a clearer sound.

The shape and kind of the domy sound wave guide 20 are diverse and may be modified and changed by those skilled in the art without departing from the spirit of the present invention.

Meanwhile, as shown in FIG. 6, an inner barrier wall 80 on which the speaker unit 60 is fixed, is installed so that an embedded speaker unit 60 or a vibration element 70 that vibrates at a low frequency band is installed in the case 30, and a sound guide tube 90, which communicates with a sound wave exhaust hole 25 of the sound wave guide 20 from the front surface of the embedded speaker unit 60, is installed so that sound wave generated in the embedded speaker unit 60 fixed on the barrier wall 80 is guided to the sound wave guide.

Thus, when due to a minimum diameter of the speaker units 10, the speaker units 10 are not directly installed in the sound wave guide 20 but the number of the speaker units 10 is increased by multi-channel design, the embedded speaker unit 60 is disposed on the barrier wall 80 so that the speaker units 10 do not overlap, and the sound wave exhaust hole 25 is formed in the sound wave guide 20 so that sound wave generated in the embedded speaker unit 60 is exhausted to the sound wave exhaust hole 25 through the sound guide tube 90 and the speaker units 10 and 60 having many numbers (many channels) are compactly installed in a narrow space.

The present invention is not limited to the above-described



embodiments, and it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

For example, the above-described embodiments are limited to a  
5 multi-channel speaker unit, such as 6.1 channel or 7.1 channel, and a multi-channel speaker unit having a variety of shapes may be applied to the above-described embodiments.

While this invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by  
10 those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

#### Industrial Applicability

15 As described above, in a multi-channel headphone according to the present invention, by using a concave sound wave guide so that a directional point at which each speaker unit faces is positioned inside an ear hole zone, sound resolution is improved, and by improving a directional sensitivity of each channel, sound separation and field  
20 sensitivity of multiple channels are increased. In addition, by respectively reflecting a part of direct sound generated in a speaker unit into a sound wave guide and changing the direct sound into indirect sound and by scattering noise caused by collision with indirect sounds or interference, spatial sensitivity and sound-field sensitivity are increased,  
25 and simultaneously, by forming the sound wave guide and scattering protrusions and by tuning a scattering ratio and reflectivity, a sound quality is improved.

What is claimed is:

1. A multi-channel headphone comprising:  
a plurality of multi-channel speaker units;  
5 a sound wave guide in which the speaker units are disposed at predetermined intervals and which has a concave inside so that a sound wave generated by the speaker units travels toward a listener's ear hole zone; and  
a case, which surrounds and protects the rear surfaces of the  
10 sound wave guide and the speaker units.
2. The headphone of claim 1, wherein each of the multi-channel speaker units comprises:  
a center-channel speaker unit, which is installed in an upper side  
15 of the sound wave guide;  
a front-channel speaker unit, which is installed in the front of the sound wave guide;  
a rear (rear-center)-channel speaker unit, which is installed in the rear of the sound wave guide;  
20 a side-channel speaker unit, which is installed in the center of the sound wave guide; and  
a multi-woofer channel speaker unit, which is installed in a lower side of the sound wave guide.
- 25 3. The headphone of claim 1 or 2, wherein a separate inner enclosure for surrounding a rear surface of the multi-channel speaker unit is formed in the multi-channel speaker unit, an enclosure of the center-channel speaker unit, the front-channel speaker unit, the side-channel speaker unit, and the rear-channel speaker unit has a  
30 closed shape, and the woofer-channel speaker unit has no enclosure, or an enclosure thereof has an opened shape (base reflector type).

4. The headphone of claim 1, wherein the sound wave guide has a domy or concave shape in which a curvature radius and a reflection/anti-reflection surface processing ratio are determined according to a ratio of desired direct wave to reflected wave, and a  
5 plurality of scattering protrusions, which induce scattering of the sound wave so that a sound field is formed inside the speaker unit, are formed in the sound wave guide, and the sound wave guide includes a first domy sound wave guide for surrounding a listener's ears and a second domy sound wave guide for surrounding each speaker unit in the first  
10 domy sound wave guide.

5. The headphone of claim 1, wherein the case has a concave inside so as to induce rear surface reflection of the base reflector type speaker unit, or a sound guide tube, which guides reflected  
15 sound wave to the sound wave guide, is installed in the case.

6. The headphone of claim 1, wherein a cushion ring is installed in a rim of the sound wave guide, and a vibration element, which vibrates at a low frequency band, is installed in the cushion ring,  
20 the sound wave guide, or the case.

7. The headphone of claim 1, wherein an inner barrier wall, on which an embedded speaker unit is fixed, is installed so that the embedded speaker unit is installed in the case, and a sound guide tube,  
25 which communicates with a sound wave exhaust hole of the sound wave guide from a front surface of the embedded speaker unit, is installed so that sound wave generated in the embedded speaker unit fixed on the barrier wall is guided to the sound wave guide.

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FIG. 1

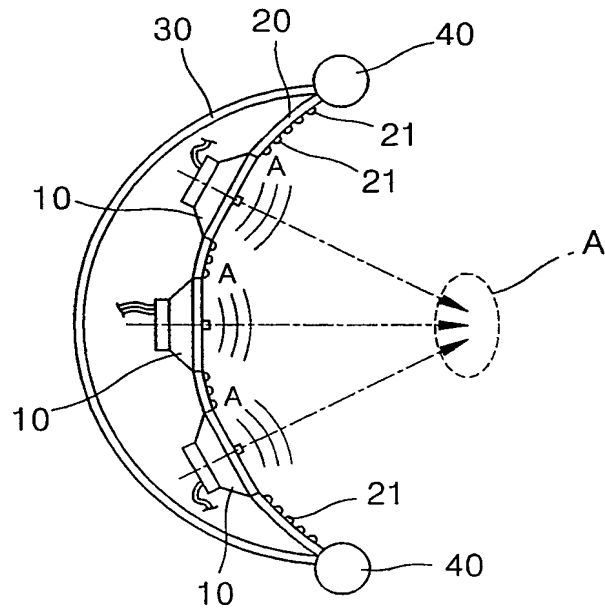
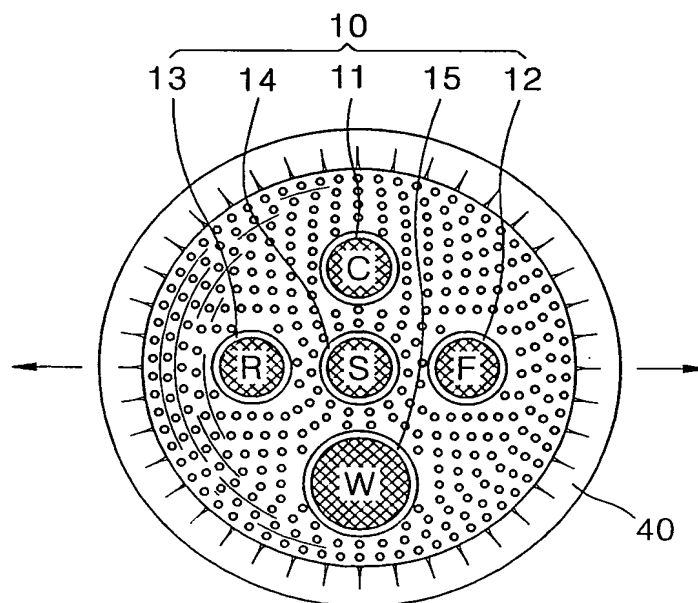


FIG. 2



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FIG. 3

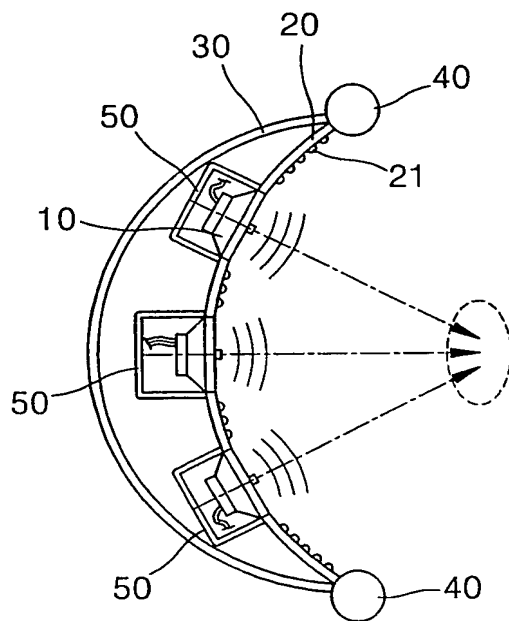
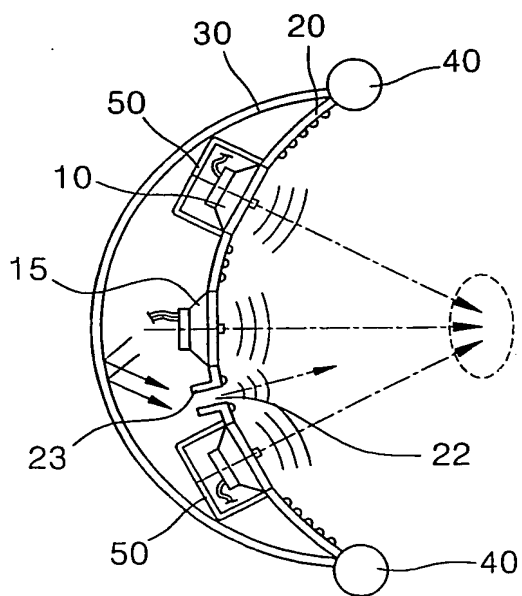


FIG. 4



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FIG. 5

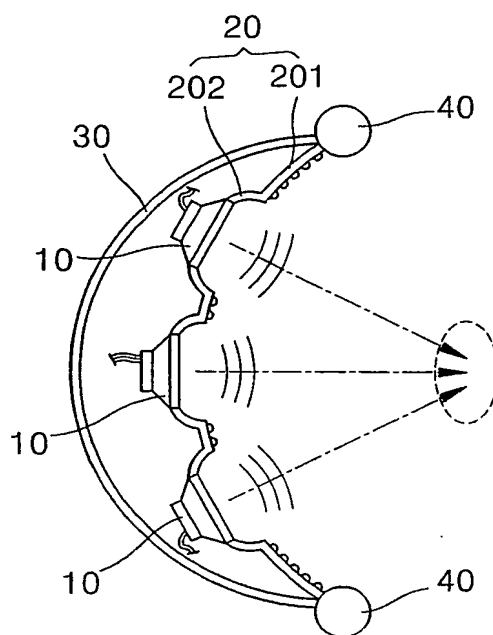
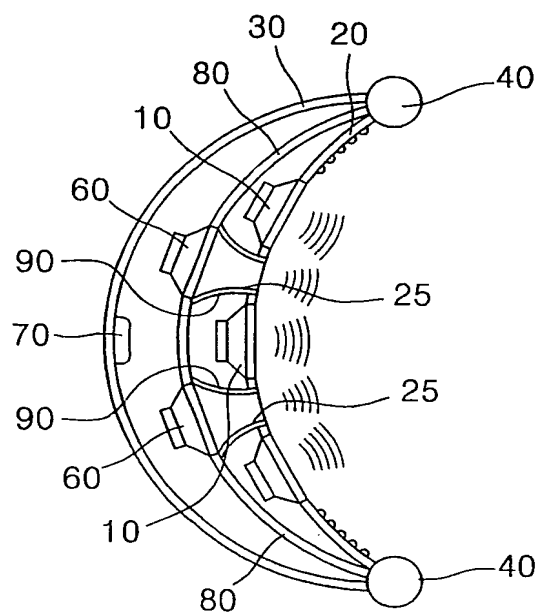


FIG. 6



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/KR2003/002551

**A. CLASSIFICATION OF SUBJECT MATTER****IPC7 H04R 1/10**

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC7 H04R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
KR, JP IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
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**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 2001-103813 A (MM GEAR CO.) 24 NOV. 2001 See Figure 2, 3	1 ~ 3, 5
Y	KR 1998-13505 A (LG ELECTRICS CO.) 30 APR. 1998 See Figure 2	1 ~ 3, 5



Further documents are listed in the continuation of Box C.



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Date of the actual completion of the international search

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